NAMRL-1133

USAARL
Serial No. 71-20

AD-729 679

EFFECTS OF ALCOHOL INGESTION ON TRACKING PERFORMANCE DURING ANGULAR ACCELERATION

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ARMY – NAVY

Joint Report

U. S. ARMY AEROMEDICAL RESEARCH LABORATORY

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY

May 1971

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Bureau of Medicine and Surgery
MF12.524.004-5001BX5G

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SUMMARY PAGE

THE PROBLEM

Most studies of the effects of alcohol on human performance have dealt with static (absence of motion) situations. However, the addition of whole-body motion, involved in such activities as piloting an aircraft, might well cause impairments not usually produced in static situations. The present study examined some of the effects of alcohol ingestion in visual tracking performance (eye-hand coordination) during angular acceleration. After practice and baseline tests of tracking performance in both static (stationary) and dynamic (whole-body angular acceleration) conditions, ten subjects received orange juice that contained 2.0 ml of 100-proof vodka per kilogram of body weight; another ten drank orange juice with a few drops of rum extract added. Tests, conducted 1, 2, 4, 8, and 10 hours after drinking, were in total darkness except for the visual display, which was illuminated to a level recommended for cockpit instruments.

FINDINGS

Static tracking errors for alcohol subjects were significantly higher than those of control subjects only at the 4-hour session. However, alcohol subjects made significantly more dynamic tracking errors than controls during 1-, 2-, and 4-hour sessions. These data suggest that eye-hand coordination may show little or no impairment following alcohol ingestion in a static situation, yet may be seriously degraded during motion.

ACKNOWLEDGMENTS

This study was conducted at the FAA's Civil Aeromedical Institute and was cosponsored by the FAA, the Army Medical Research and Development Command, and the Naval Aerospace Medical Research Laboratory. Drs. Collins and Schroeder are associated with the Civil Aeromedical Institute in Oklahoma City. The authors gratefully acknowledge the expert assistance of Carl Moore in obtaining blood samples, and of Elizabeth Gilson, Carlyn Manley, Cynthia Coc ran, and Blair Fennell in the collection and scoring of data. Gas chromatographic analyses of the blood samples were performed under contract by Dr. Kurt Dubowski, University of Oklahoma Medical Center.

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INTRODUCTION

Schroeder (7,8) has shown that the ingestion of alcohol depresses both nystagmus and "vertigo" sensations during rotatory or caloric vestibular stimulation when subjects are in darkness, but in illumination similarly provoked nystagmus is considerably stronger than it is normally. This poses some obvious questions regarding the ability of men to perform visual tasks requiring fixation during vestibular stimulation after drinking alcohol. Most studies of the effects of alcohol on human performance have involved static situations; i.e., situations in which the men were not subjected to motion. It is conceivable that the addition of motion, which is involved in a variety of activities, such as piloting an aircraft or driving an automobile, might produce deleterious effects on performance not usually obtained in static situations. Therefore, the present study was designed to examine some of the effects of alcohol ingestion on visual tracking performance during angular accelerations.

PROCEDURE

SUBJECTS

Twenty male college students, paid volunteers ranging in age from 21 to 30 years, served as subjects. None had previous laboratory experience involving vestibular stimulation. Each subject was assigned at random to one of two equal groups: a control and an alcohol group.

APPARATUS

Angular acceleration was supplied by a Stille-Werner RS-3 rotator fitted with a small cockpit (see Figure 1) in which the subject was enclosed and seated upright with his horizontal semicircular canals approximately in the plane of rotation. A fitted headrest helped to maintain the desired position. A triangular waveform input from a Wavetek model-155 waveform generator was used as a command signal for the rotator. The velocity of the latter was proportional to the input voltage, and a peak angular velocity of 120 deg/sec was attained in both the clockwise and counterclockwise directions. The waveform period was 48 seconds.

A compensatory visual tracking task provided both a direct practical measure of performance and an indirect measure of acuity. The tracking apparatus has been described in detail elsewhere (3). Briefly, a 14-second sinusoidal "forcing function" input deflected the vertical needle of an aircraft localizer/glide-slope indicator while the subject attempted to maintain the needle in the null position by manipulation of a control stick. Deviations of the needle from this position were considered errors, and a voltage proportional to these deviations was electronically integrated over consecutive 1-second intervals throughout a trial.

The display was illuminated by a 3V - DC-bulb mounted in a tube in front of the subject, but below his line of sight (see Figure 2). Light was projected through the

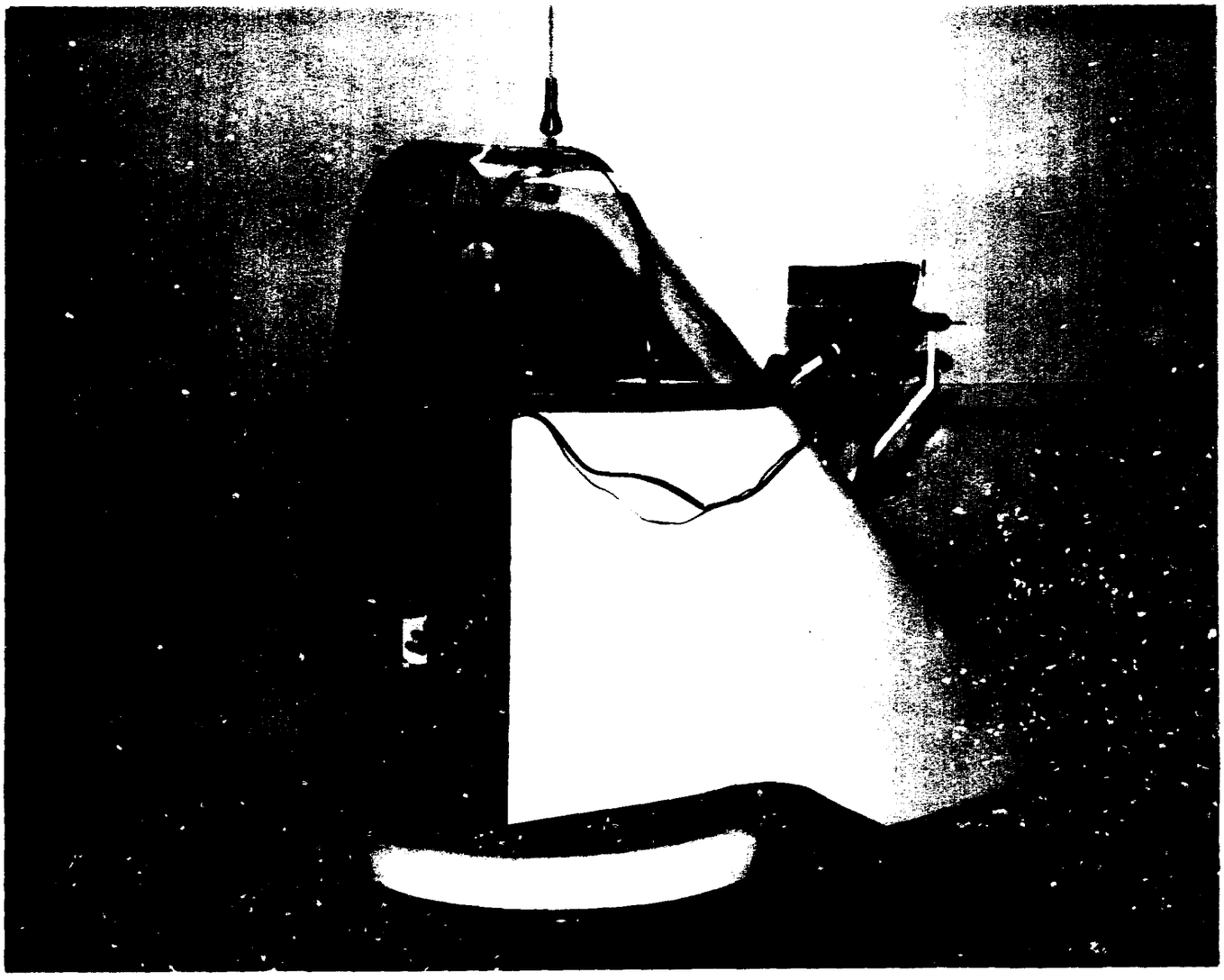


Figure 1

Rotation device with visual display attached.

Figure 2

View of visual display from inside rotator. With room lights turned out, only instrument dial and a dim, partial outline of cabin interior could be seen by the subject.

tube to localize on the display and to minimize reflection in the otherwise darkened room. The luminance of the display was measured with the aid of a card sprayed with the same white paint as the display needle. This card was placed in the light, just in front of the display, and measurements were made with a MacBeth illuminometer from the subject's viewing position. The voltage across the bulb was adjusted until the luminance was 1 ft-L, a level recommended for aircraft instruments (5).

RECORDING

Silver disk electrodes taped to the outer canthi of the eyes and a reference electrode on the forehead were used to record eye movements by the corneoretinal potential method with a 3-second preamplification time constant. Calibration of horizontal eye movements was accomplished with two small, alternately flashing lights, horizontally separated to subtend a visual angle of 15 degrees. Integrated tracking error, eye movements, and rotational velocity were simultaneously displayed on an Offner type-T electroencephalograph.

ALCOHOL INGESTION

Subjects in the alcohol group consumed a mixture of 100-proof vodka and orange juice. The mixture (900 ml) contained 2 ml of vodka per kilogram of body weight. Control subjects received only orange juice with a few drops of rum extract added to alter the odor and taste of the beverage. (They were led to believe that they were drinking alcohol.) All subjects consumed their drinks within a 30-minute period.

METHOD

Prior to being tested, each subject was given 5 minutes of tracking practice with the cockpit stationary. The experimental sequence which followed comprised six testing sessions: a pre-drinking session and five sessions at 1, 2, 4, 8, and 10 hours after drinking. All sessions, practice and experimental, were conducted with the room in total darkness except for the visual display. Immediately before each testing session, venous blood samples of from 3 cc to 5 cc were drawn for analysis of blood alcohol levels by gas chromatography. Tests of positional alcohol nystagmus (PAN) were also performed; these are described in Appendix A.

Each session consisted of a 2-minute "static" tracking trial with the cockpit stationary and a 4-minute "dynamic" tracking trial with the cockpit rotating through five complete cycles (240 seconds). The order of these trials was alternated across subjects, and at least a 1-minute interval was allowed between trials. Eye-movement calibrations were obtained prior to each period of dynamic tracking.

SCORING

The tracking errors for 1-second intervals were summed, and an average value was obtained for each static and dynamic trial.

Measures of nystagmus included the number of nystagmic beats and the amount of slow phase eye displacement during each dynamic tracking trial; one sampling interval was 32 to 37 seconds from the start, one was 131 to 136 seconds from the start, and the other was 10 to 15 seconds from the end of each trial (i.e., three differently placed 5-second intervals). The sampling intervals were chosen to include maximum nystagmus output in a single direction near the beginning, middle, and end of each test period. Mean values in degrees per second or beats per second were calculated and used to represent nystagmus output.

RESULTS

The following mean values of ethanol were obtained for the pre-drinking, 1-, 2-, 4-, 8-, and 10-hour samples, respectively, from the alcohol group: 0 per cent, 0.074 per cent, 0.073 per cent, 0.047 per cent, 0.001 per cent, and 0 per cent. Control group subjects yielded no evidence of ethanol in their blood samples (see Appendix B).

Means and standard deviations for tracking error and for the slow phase and frequency measures of nystagmus for both static and dynamic conditions appear in Table I (individual scores are in Appendices C through F). Changes in performance across sessions are shown in Figure 3 where they are presented as percentages of increase or decrease in tracking error based on the pre-drinking level. Representative tracings of nystagmus during dynamic tracking are depicted in Figure 4, and plots of the nystagmic measures across sessions are in Figure 5.

CONTROL GROUP

The control group evidenced only a slight decline in static tracking error (an expected improvement with practice) from the pre-drinking through the 10-hour sessions. None of the changes was statistically significant (Table II). However, dynamic tracking error evidenced a fairly steady decline from the pre-drinking through the 10-hour testing sessions; all 1- to 10-hour error scores for the control group were significantly ($p < .05$ and $< .01$) below the pre-drinking scores (Table II). Frequency measures of nystagmus for control subjects showed no significant change (see Table II) across the six sessions; although, in all but the last session slow phase velocity was significantly below ($p < .05$ and $< .01$) the pre-test level of slow phase activity.

ALCOHOL GROUP

In contrast to control subjects, both the average static and dynamic tracking errors increased for the alcohol group at the 1-, 2-, and 4-hour testing sessions; however, only the increase for the 1-hour static session ($p < .05$) and for the 1- and 2-hour dynamic sessions ($p < .01$ and $< .05$, respectively) were significantly above the respective pre-drinking values (Table II). Measures of nystagmus for alcohol subjects also presented a totally different picture from that of the control group. Both the degrees per second and the beats per second measures increased significantly ($p < .05$

Table 1

Means and Standard Deviations by Session for Tracking Error (Arbitrary Units), Slow Phase Nystagmus (deg/sec), and Frequency of Nystagmus (beats/sec)

Measure	Group	Condition		Session					
				Pre	1-Hour	2-Hour	4-Hour	8-Hour	10-Hour
Performance:									
Tracking Error	Control	Static	Mean	5.43	5.21	4.74	4.51	4.77	4.73
			SD	1.71	0.86	0.52	0.59	0.41	0.53
	Control	Dynamic	Mean	6.73	5.44	5.06	4.88	4.91	4.50
			SD	1.86	0.65	0.65	0.52	0.51	0.55
Tracking Error	Alcohol	Static	Mean	5.29	5.92	5.86	5.78	4.74	4.84
			SD	1.46	1.15	1.01	1.28	1.74	0.62
	Alcohol	Dynamic	Mean	5.97	7.51	6.85	6.02	4.70	4.89
			SD	1.14	0.82	1.13	0.88	1.32	0.54
Nystagmus:									
Slow Phase	Control	Dynamic	Mean	5.42	3.30	3.29	3.06	2.35	3.10
			SD	2.83	2.16	1.81	2.24	1.37	1.54
Frequency	Control	Dynamic	Mean	1.40	1.54	1.57	1.42	1.16	1.24
			SD	0.91	1.05	0.86	0.94	0.75	0.73
Slow Phase	Alcohol	Dynamic	Mean	3.85	12.15	9.16	6.01	2.82	2.82
			SD	3.10	5.45	4.60	4.54	2.31	3.18
Frequency	Alcohol	Dynamic	Mean	1.53	3.70	3.31	2.51	1.29	1.19
			SD	1.10	1.06	1.09	1.16	0.83	0.72

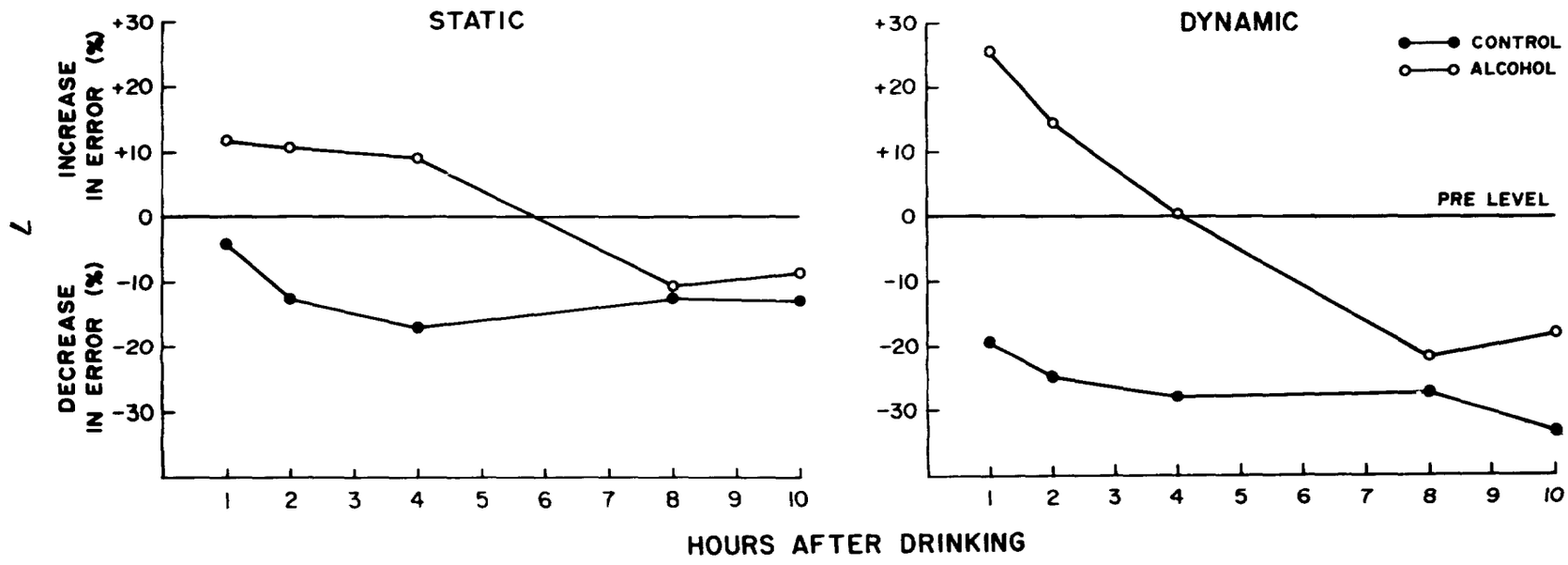
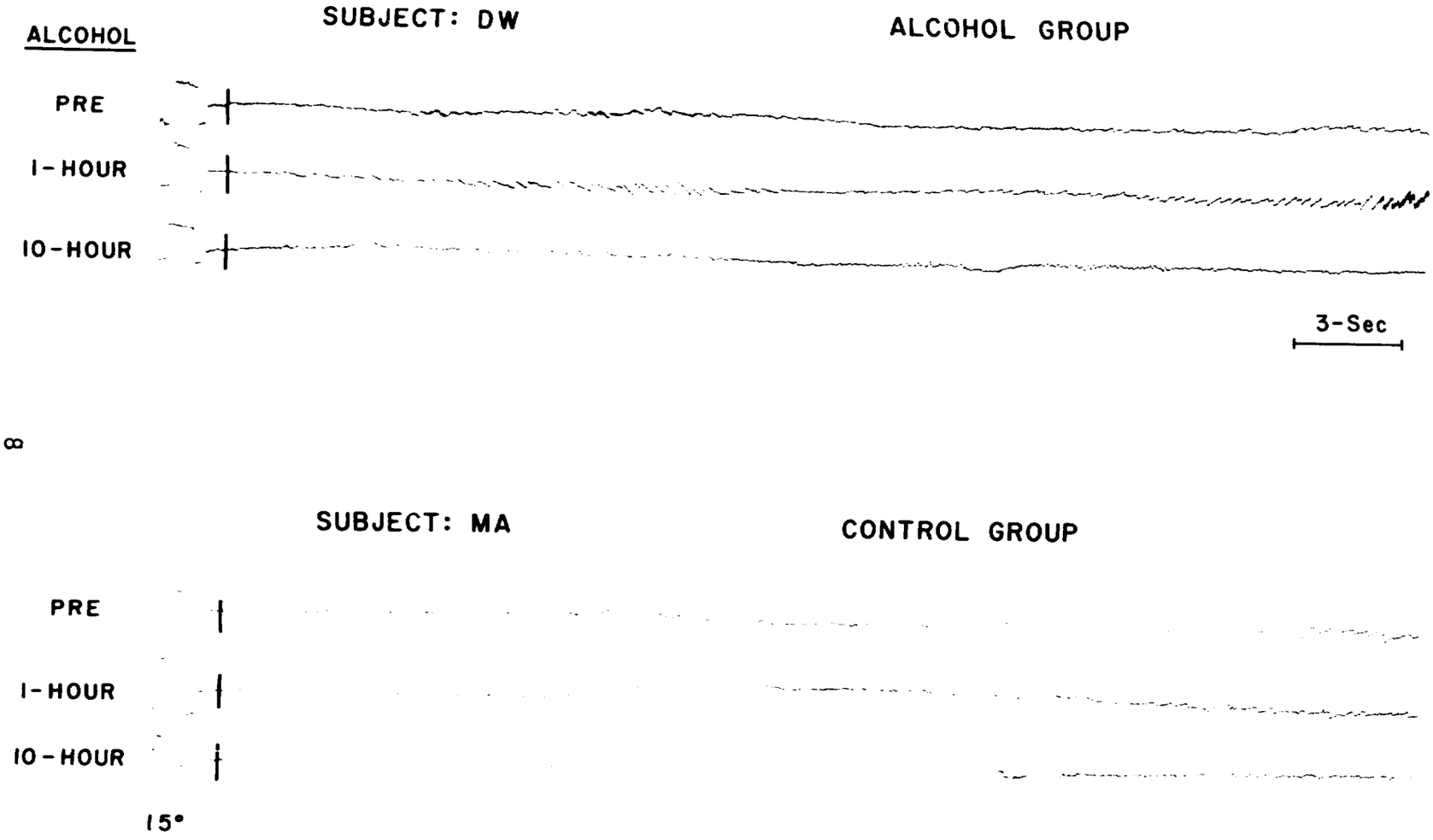


Figure 3

Changes in tracking error under static (stationary) and dynamic (angular acceleration) conditions. Zero (0) lines represent base levels of tracking error during preliminary trials. Tracking error scores for the five post-drinking sessions were converted to percentages of increase or decrease from base levels.



INSTRUMENT DIAL ILLUMINATION LEVEL: 1.0 FOOT LAMBERT

Figure 4

Tracings of nystagmus during angular accelerations. Increased eye-movement activity clearly increases following alcohol ingestion.

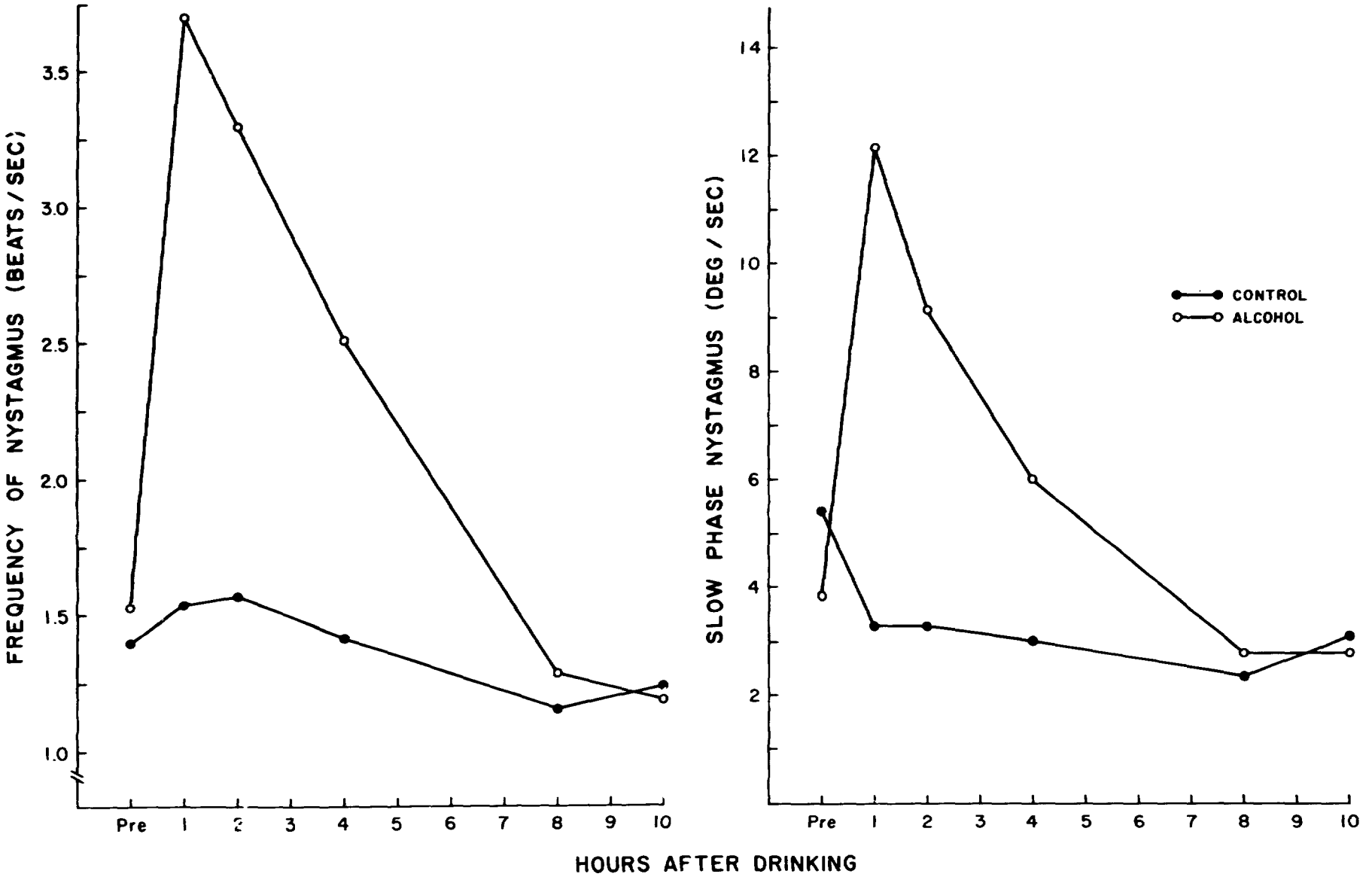


Figure 5

Output of sampled nystagmus during each test session for the control and alcohol subjects.

Table II

Results of t-Tests between Pre-Drinking and Post-Drinking Measure of Slow Phase Displacement and Frequency of Nystagmus Resulting from Angular Acceleration, and of Tracking Error under Static and Dynamic Conditions

Measure	Group	Nystagmus Comparisons: Pre vs. 1-Hour	2-Hour	4-Hour	8-Hour	10-Hour
Slow Phase	Alcohol	-7.09***	-6.31***	-2.44*	+1.70	+1.04
	Control	+3.67**	+2.84*	+2.80*	+3.59**	+2.23
Frequency	Alcohol	-6.58***	-6.38***	-3.69**	+0.86	+1.33
	Control	-0.95	-1.02	-0.17	+1.04	+0.91
Condition	**Group**	**Tracking Error Comparisons: Pre vs. 1-Hour**	**2-Hour**	**4-Hour**	**8-Hour**	**10-Hour**
Static	Alcohol	-2.96*	-2.23	-1.88	+0.89	+1.24
	Control	+0.48	+1.19	+1.69	+1.15	+1.29
Dynamic	Alcohol	-4.00**	-3.12*	-0.32	+2.60*	+3.94**
	Control	+2.38*	+3.05*	+3.35**	+3.25**	+3.64**

* $p < .05$
** $p < .01$
*** $p < .001$

to < .001) from the pre-tests through the 1-, 2-, and 4-hour tests. At the 8- and 10-hour tests, nystagmus was below the pre-drinking levels, but not significantly (see Table II).

COMPARISON OF THE CONTROL AND ALCOHOL GROUPS

In comparing the two groups, t-tests were conducted on "change" (or difference) scores; i.e., the differences in scores between the pre-drinking and the 1-hour sessions, the pre-drinking and the 2-hour sessions, et cetera (see Table III).

Static tracking differences between the control and alcohol groups were significant ($p < .05$) only for the 4-hour session. However, in the dynamic condition, differences between the two groups were significant ($p < .01$ and $< .001$) at the 1-, 2-, and 4-hour sessions; thus, with the addition of motion, the alcohol group performed with significantly more errors than the control group during the first 4 hours after drinking (Table III).

With respect to nystagmus, the control group had significantly less slow phase velocity ($p < .001$) and frequency of nystagmus ($p < .01$ and $< .001$) than did the alcohol group for the 1-, 2-, and 4-hour sessions, and significantly less slow phase nystagmus ($p < .05$) for the 8-hour session. Thus, the alcohol subjects were less able than control subjects to suppress their eye movements by fixation on the visual display during angular acceleration.

Table III

Results of t-Tests Comparing Alcohol Subjects with Control Subjects on Measures of Nystagmus and Tracking Error#

Nystagmus Measure	Comparisons: Alcohol vs. Control Group				
	1-Hour	2-Hour	4-Hour	8-Hour	10-Hour
Slow Phase	8.24***	7.55***	4.37***	2.20*	1.03
Frequency	5.44***	4.82***	3.56**	0.00	-0.56
Tracking Error					
Static	1.70	1.06	2.13*	0.12	0.38
Dynamic	4.25***	4.14***	3.31**	0.74	1.72

Comparisons were made between difference scores for each session (i.e., the difference in scores of each post-drinking session from those of the pre-drinking session).

* $p < .05$ ** $p < .01$ *** $p < .001$

DISCUSSION

Although alcohol effected an increase in tracking errors during static performance tests, the increase was significantly above pre-drinking levels only during the 1-hour session. Moreover, differences between the alcohol and control groups in static tracking error were significant only during the 4-hour session when the effects of alcohol were beginning to wane.

During vestibular stimulation, however, the eye-hand coordination required by the tracking task showed marked impairment by alcohol for the 1- and 2-hour sessions in comparison with the alcohol group's pre-drinking performance and for the 1-, 2-, and 4-hour sessions in comparison with the steady improvement demonstrated by the control group. The extent of this impairment appears to be directly correlated with the increased nystagmic activity from angular accelerations following alcohol ingestion. Thus, degradation of eye-hand coordination during stimulation of the semicircular canals appears to be closely related to the alcohol-induced loss of the ability to maintain adequate visual fixation on an object and thereby to inhibit nystagmus, resulting in loss of visual acuity. A similar degradation of visual acuity and tracking performance without alcohol has been reported previously (3,4). However, the magnitude of vestibular stimuli for commensurate losses was necessarily greater in those studies since, without alcohol, the visual fixation mechanism suppressing nystagmus was functioning normally.

These data have several practical implications. Activities that show little or no impairment following alcohol ingestion in static situations may be seriously degraded during motion. Further, the task required of the subjects here was a relatively simple one; i.e., the subject could concentrate on the single stimulus display. However, in many work activities, such as piloting an aircraft, the attention of the pilot has to shift from one stimulus "display" to another. It has been shown that deleterious effects of alcohol on performance in static situations are greatest when time-sharing of attention across several tasks is required (1) or if the task requires "divided attention" (6). The addition of motion to a complex time-sharing task where performance is already degraded by alcohol might be especially hazardous.

As a final point, it should be noted that the average blood-alcohol levels obtained in this study were considerably below the levels legally defined as intoxication by most state motor-vehicle statutes. (The District of Columbia and 23 state laws cite a blood alcohol level of 0.15 per cent or more as a presumptive legal index; 21 states use 0.10 per cent. Utah uses 0.08 per cent as presumptive, and several other states are considering reducing their current levels to 0.08 per cent. Five states have no defined levels (2)). Only three subjects exceeded 0.09 per cent during any of the blood-sampling periods.

REFERENCES

1. Chiles, W. D., and Jennings, A. E., Effects of alcohol on complex performance. Human Factors, 12:605-612, 1970.

2. Erwin, R. E., Defense of drunk driving cases, criminal-civil (Second Ed.): 1970 cumulative supplement including appendix of pertinent statutes and supplemental index. New York: Matthew Bender & Co., Inc., 1970.

3. Gilson, R. D., Guedry, F. E., and Benson, A. J., Influence of vestibular stimulation and display luminance on the performance of a compensatory tracking task. Aerospace Med., 41:1231-1237, 1970.

4. Guedry, F. E., Relations between vestibular nystagmus and visual performance. Aerospace Med., 39:570-579, 1968.

5. Morgan, C. T., Cook, J. S., Chapanis, A., and Lund, M. W. (Eds.), Human Engineering Guide to Equipment Design. New York: McGraw-Hill, 1963.

6. Moskowitz, H., and DePry, D., Differential effects of alcohol on auditory vigilance and divided-attention tasks. Quart. J. Stud. Alc., 29:54-64, 1968.

7. Schroeder, D. J., Influence of alcohol on vestibular responses to angular acceleration. Aerospace Med., 1971, in press.

8. Schroeder, D. J., Alcohol and disorientation-related responses. I. Nystagmus and "vertigo" during caloric and optokinetic stimulation. AM 71-6. Oklahoma City, Okl.: FAA, Civil Aeromedical Institute, 1971.

APPENDIX A
Positional Alcohol Nystagmus

To provide possibly useful supplementary information, tests of positional alcohol nystagmus were performed before each testing session and immediately after the blood samples were drawn. The subject assumed a supine position and was instructed to position his head upright, to the left, upright, to the right, and upright again, while in total darkness with his eyes open. Each position was held for 45 seconds while the subject performed a mental arithmetic task. Nystagmic responses were recorded on an Offner type-TC electroencephalograph, and calibration was accomplished prior to each positional series by instructing the subject to sweep his eyes between special ceiling markers subtending 20 degrees of visual angle.

Ratings of positional nystagmus showed fairly consistent results. PAN I responses were rated as strong and as about equally vigorous during the 1-hour and 2-hour post-drinking sessions; a reduction in output of about two-thirds occurred in the 4-hour session. All but one subject showed typical PAN I responses; the exception (subject BR) gave only weak occasional nystagmus. PAN II responses were obtained from eight subjects during the 8-hour session and were rated as being slightly more vigorous than the 4-hour PAN I nystagmus. Only five subjects yielded PAN II responses during the 10-hour session.

APPENDIX B

Blood Alcohol Levels in Per Cent Determined by Gas Chromatography for Alcohol and Control Subjects

Control Group		Alcohol Group						
			Session					
Subject	Pre	Subject	Pre	1-Hour	2-Hour	4-Hour	8-Hour	10-Hour
MK	0	MB	0	0.077	0.063	0.042	0	0
MA	0	BR	0	0.057	0.070	0.053	0	0
SM	0	MC	0	0.040	0.055	0.022	0.002	0
PS	0	DW	0	0.064	0.066	0.050	0	0
RC	0	BB	0	0.103	0.086	0.054	0	0
BS	0	JH	0	0.059	0.087	0.047	0.006	0
JC	0	JU	0	0.103	0.075	0.056	0	0
RM	0	BO	0	0.068	0.079	0.054	0.002	0
AA	0	GP	0	0.063	0.067	0.034	0.003	0
TT	0	DB	0	0.101	0.079	0.054	0	0
Mean	0	Mean	0	0.074	0.073	0.047	0.001	0
SD	0	SD	0	0.021	0.010	0.010	0.002	0

APPENDIX C

Control Group: Tracking Error in Arbitrary Units under Static and Dynamic Conditions

Condition	Subject	Session					
		Pre-	1-Hour	2-Hour	4-Hour	8-Hour	10-Hour
Static	MK	2.89	3.79	3.63	3.01	4.09	3.98
	MA	5.76	5.20	4.25	4.25	4.59	4.84
	SM	4.23	5.50	5.32	5.05	5.36	4.34
	PS	4.56	5.12	5.19	5.13	5.41	5.31
	RC	5.54	5.56	4.90	5.07	4.68	5.93
	BS	3.40	4.20	4.80	4.50	4.60	4.20
	JC	6.90	6.06	4.67	4.24	4.33	4.80
	RM	4.86	5.16	5.16	4.46	4.78	4.56
	AA	7.94	6.94	5.21	4.82	5.17	4.77
	TT	8.17	4.54	4.27	4.60	4.68	4.54
	Mean	5.43	5.21	4.74	4.51	4.77	4.73
	SD	1.71	0.86	0.52	0.59	0.41	0.53
Dynamic	MK	5.53	4.64	4.23	3.96	3.94	3.77
	MA	6.96	5.68	5.60	4.74	5.46	4.26
	SM	5.90	5.35	4.69	5.01	5.07	5.15
	PS	5.69	6.23	5.15	5.26	5.50	5.46
	RC	7.34	6.33	6.45	5.76	5.36	4.94
	BS	3.71	4.08	4.06	4.24	4.39	3.84
	JC	9.19	5.89	4.95	5.29	4.85	4.62
	RM	4.95	5.42	5.13	4.82	4.42	4.39
	AA	10.04	5.56	5.43	5.25	5.35	3.70
	TT	8.01	5.21	4.88	4.44	4.72	3.88
	Mean	6.73	5.44	5.06	4.88	4.91	4.50
	SD	1.86	0.65	0.65	0.52	0.51	0.55

APPENDIX D

Alcohol Group: Tracking Error in Arbitrary Units under Static and Dynamic Conditions

Condition	Subject	Session					
		Pre	1-Hour	2-Hour	4-Hour	8-Hour	10-Hour
Static	MB	4.79	4.90	4.98	4.96	3.50	4.57
	BR	5.36	5.21	5.31	4.95	1.66	4.31
	MC	4.13	4.98	4.36	3.99	2.45	4.66
	DW	4.25	5.88	5.73	5.26	5.79	4.38
	BB	4.54	5.59	5.81	5.57	5.68	4.15
	JH	4.42	4.98	5.38	5.27	4.09	4.20
	JU	6.32	6.69	7.04	7.91	7.81	5.95
	BO	8.03	8.47	7.78	8.02	6.03	5.63
	GP	7.60	7.36	6.94	6.86	5.09	5.56
	DB	3.45	5.12	5.30	5.01	5.27	4.97
	Mean	5.29	5.92	5.86	5.78	4.74	4.84
	SD	1.46	1.15	1.01	1.28	1.74	0.62
Dynamic	MB	5.06	7.03	6.40	5.41	3.79	4.81
	BR	6.00	6.79	5.99	5.58	2.48	4.79
	MC	4.93	6.80	5.39	4.75	3.00	4.08
	DW	5.65	6.77	5.79	5.85	5.42	4.66
	BB	5.18	8.79	7.78	5.57	4.99	4.36
	JH	5.79	8.65	7.15	5.99	4.02	4.34
	JU	6.41	7.86	8.19	6.63	7.16	5.66
	BO	7.95	8.42	8.49	7.86	5.68	5.68
	GP	8.10	7.42	7.87	7.13	4.90	5.54
	DB	4.65	6.53	5.42	5.45	5.55	5.01
	Mean	5.97	7.51	6.85	6.02	4.70	4.89
	SD	1.14	0.82	1.13	0.88	1.32	0.54

APPENDIX E

Control Group: Nystagmus Measures Based on Three 5-Second Samples from Each Session for Each Subject

Measure	Subject		Session					
			Pre	1-Hour	2-Hour	4-Hour	8-Hour	10-Hour
Slow Phase Nystagmus (deg/sec)	MK		1.3	1.2	2.7	0.0	0.0	0.5
	MA		5.3	3.9	2.6	2.6	2.8	2.5
	SM		4.8	5.1	4.1	4.8	3.8	6.3
	PS		10.9	6.7	7.9	8.2	3.2	4.8
	RC		10.3	7.1	5.0	4.2	4.4	3.9
	BS		5.3	2.2	2.4	2.2	2.9	3.2
	JC		3.9	2.5	2.0	2.5	2.3	1.9
	RM		4.2	1.9	2.3	1.8	2.6	2.3
	AA		5.0	1.3	2.1	3.8	1.3	3.3
	TT		3.2	1.1	1.8	0.5	0.2	2.3
		Mean	5.42	3.30	3.29	3.06	2.35	3.10
		SD	2.83	2.16	1.81	2.24	1.37	1.54
Frequency of Nystagmus (beats/sec)	MK		0.2	0.2	0.6	0.0	0.0	0.3
	MA		2.4	2.7	2.2	2.0	1.7	1.9
	SM		0.9	2.5	2.5	2.5	2.2	2.1
	PS		3.0	3.0	3.1	2.9	1.9	2.4
	RC		2.3	2.7	2.4	2.2	1.7	1.7
	BS		1.7	1.4	1.5	1.3	0.9	1.4
	JC		1.6	1.4	1.1	1.6	1.5	0.8
	RM		1.1	0.9	0.8	0.9	1.3	1.0
	AA		0.3	0.3	0.6	0.6	0.3	0.5
	TT		0.5	0.3	0.9	0.2	0.1	0.3
		Mean	1.40	1.54	1.57	1.42	1.16	1.24
		SD	0.91	1.05	0.86	0.94	0.75	0.73

APPENDIX F

Alcohol Group: Nystagmus Measures Based on Three 5-Second Samples from Each Session for Each Subject

Measure	Subject		Session					
			Pre	1-Hour	2-Hour	4-Hour	8-Hour	10-Hour
Slow Phase Nystagmus (deg/sec)	MB		9.9	24.4	20.9	17.0	7.4	4.9
	BR		6.5	12.8	10.2	11.3	6.1	11.6
	MC		1.5	13.5	9.4	4.8	3.7	2.6
	DW		4.2	17.5	10.1	5.5	1.9	1.0
	BB		3.3	11.5	9.5	6.0	3.4	2.0
	JH		3.9	7.9	5.7	3.4	2.3	2.3
	JU		7.5	13.8	11.0	5.0	2.5	1.7
	BO		0.0	8.0	5.8	4.1	0.1	0.6
	GP		0.3	4.8	3.5	0.1	0.0	0.2
	DB		1.4	7.3	5.5	2.9	0.8	1.3
		Mean	3.85	12.15	9.16	6.01	2.82	2.82
		SD	3.10	5.45	4.60	4.54	2.31	3.18
Frequency of Nystagmus (beats/sec)	MB		3.5	5.0	4.9	4.7	2.7	2.6
	BR		2.5	4.8	4.3	3.7	2.0	2.0
	MC		0.6	4.8	4.1	2.7	2.1	1.8
	DW		2.3	4.8	4.1	2.7	0.9	0.7
	BB		1.7	3.0	3.5	3.1	1.9	1.1
	JH		1.5	2.7	2.3	1.8	1.3	1.3
	JU		2.4	3.6	3.4	2.1	1.1	1.0
	BO		0.0	3.6	3.0	2.1	0.2	0.4
	GP		0.1	1.7	1.0	0.1	0.0	0.1
	DB		0.7	3.0	2.5	2.1	0.7	0.9
		Mean	1.53	3.70	3.31	2.51	1.29	1.19
		SD	1.10	1.06	1.09	1.16	0.83	0.72

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY *(Corporate author)*
Naval Aerospace Medical Research Laboratory
Naval Aerospace Medical Center
Pensacola, Florida 32512

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP
N/A

3 REPORT TITLE
EFFECTS OF ALCOHOL INGESTION ON TRACKING PERFORMANCE DURING ANGULAR ACCELERATION

4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

5 AUTHOR(S) *(First name, middle initial, last name)*
William E. Collins, Lieutenant Richard D. Gilson, USNR, David J. Schroeder, and Fred E. Guedry, Jr.

6 REPORT DATE	7a. TOTAL NO OF PAGES	7b. NO OF REFS
18 May 1971	20	8

8a. CONTRACT OR GRANT NO

b. PROJECT NO.
MF12.524.004-5001BX5G

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)
NAMRL-1133

9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
USAARL Serial No. 71-20

10 DISTRIBUTION STATEMENT
Approved for public release; distribution unlimited.

11 SUPPLEMENTARY NOTES
Joint report with U. S. Army Aeromedical Research Laboratory, Fort Rucker, Alabama

12 SPONSORING MILITARY ACTIVITY

13 ABSTRACT

Following practice, two groups of 10 subjects each were given pre- (baseline) tests of tracking performance in both static (stationary) and dynamic (whole body angular acceleration) conditions. One group then received orange juice which contained 2.0 ml of 100-proof vodka per kg of subject weight; the other group drank orange juice with a few drops of rum extract added. All subjects were led to believe that they were receiving alcohol. Additional tests were conducted 1, 2, 4, 8, and 10 hours after drinking. All tests were in total darkness with the exception of the visual display which was illuminated to a level recommended for cockpit instruments. Static tracking error declined slightly for the control group, but increased over the pre-drinking level during the 1-, 2-, and 4-hour tests for the alcohol group; only the 1-hour scores differed significantly from the pre-scores for the alcohol group. In comparing the two groups, static tracking errors for alcohol subjects were significantly higher than those of control subjects only at the 4-hour session when the effects of alcohol were beginning to wane. However, in the dynamic tests, alcohol subjects made significantly more tracking errors than control subjects during the 1-, 2-, and 4-hour sessions. These data suggest that eye-hand coordination may show little or no impairment following alcohol ingestion in static situations, yet may be seriously degraded during motion.

DD FORM 1 NOV 65 1473 (PAGE 1)

S/N 0101-807-6801

Unclassified

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Tracking performance						
Alcohol						
Vestibular stimulation						
Angular acceleration						
Nystagmus						